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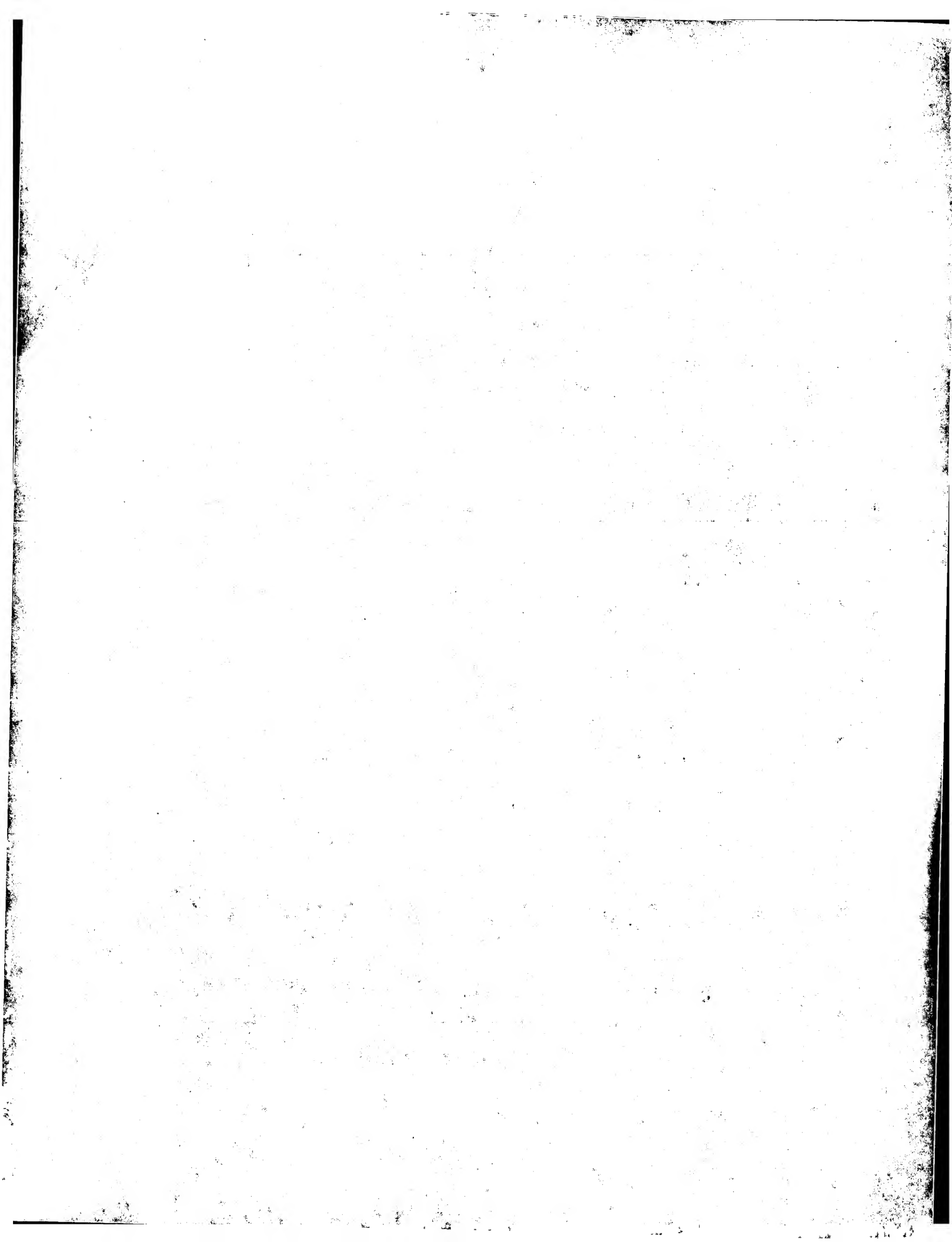
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**C1P PD P109 P209**

(56) Documents Cited

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(58) Field of Search

**UK CL (Edition N ) C1P PD PE PP PW**

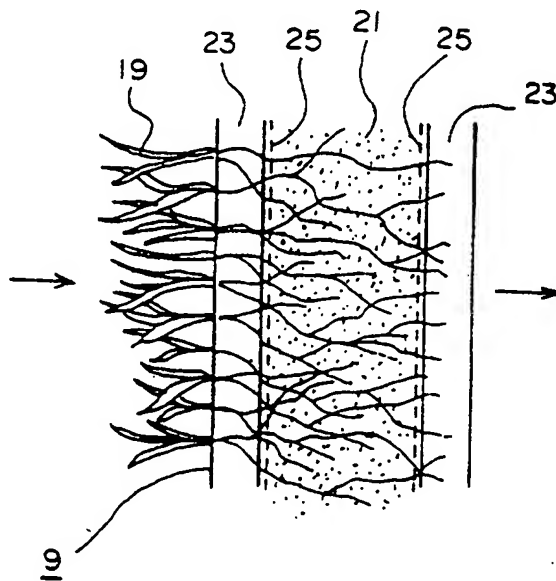
**INT CL<sup>6</sup> A61L 9/12 , B01D 53/00 53/85**

**Online databases: WPI, CLAIMS**

(54) **Purifying contaminated air by passage through soil**

(57) Contaminated air is purified by passing through a wall (9) which is composed of a soil layer (21) populated with microorganisms, the soil layer (21) allowing air to pass therethrough, and a supporting member (23, 25) allowing air to pass therethrough. Plants (19) are cultivated on the soil layer. The supporting member (23, 25) comprises a pair of soil holders disposed in sandwiching relation to the soil layer (21) and a frame supporting the soil holders.

FIG.5



GB 2 297 087

FIG. 1

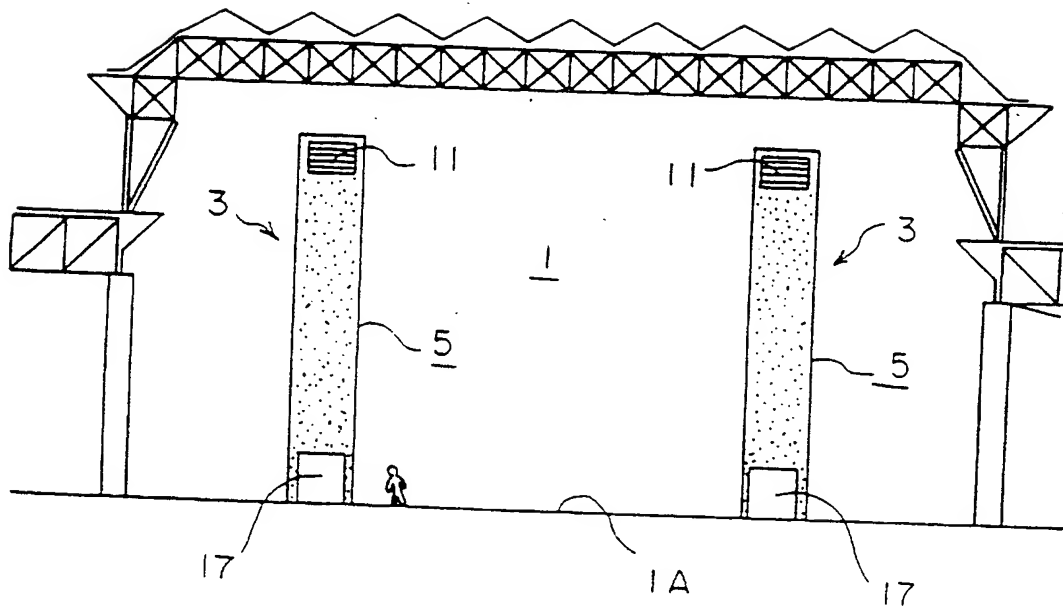


FIG 2

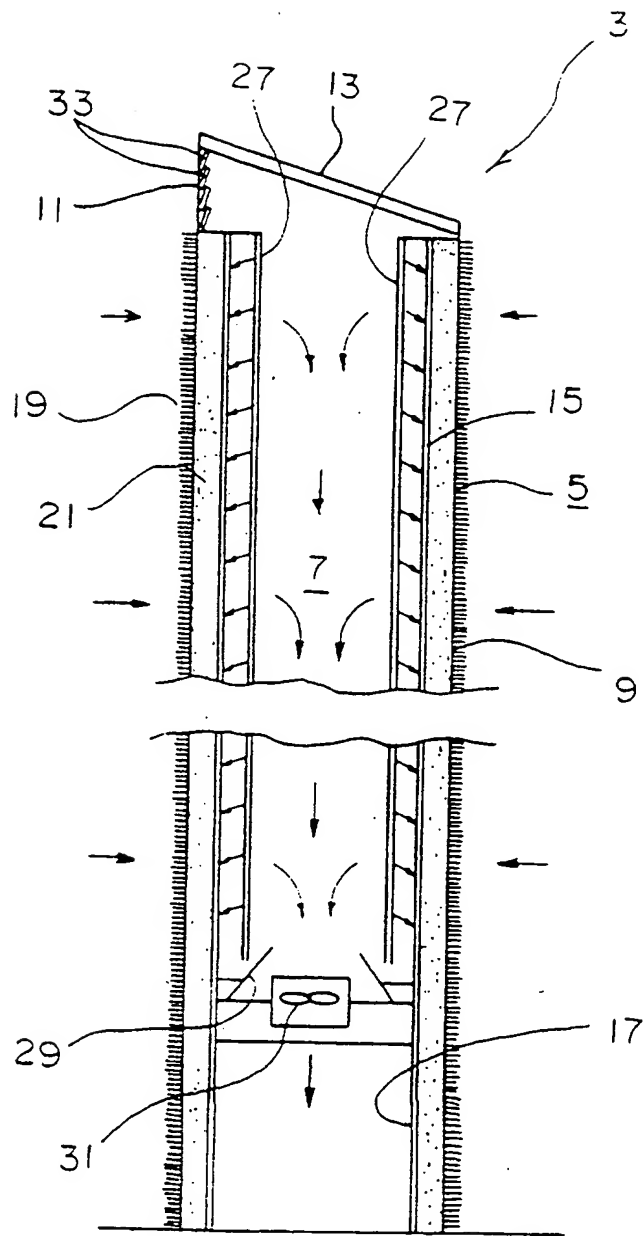


FIG. 3

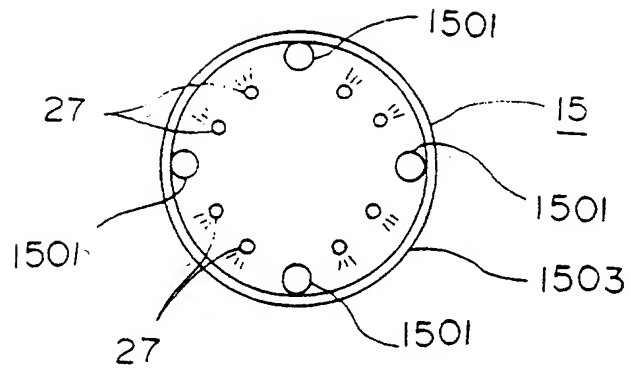


FIG. 4

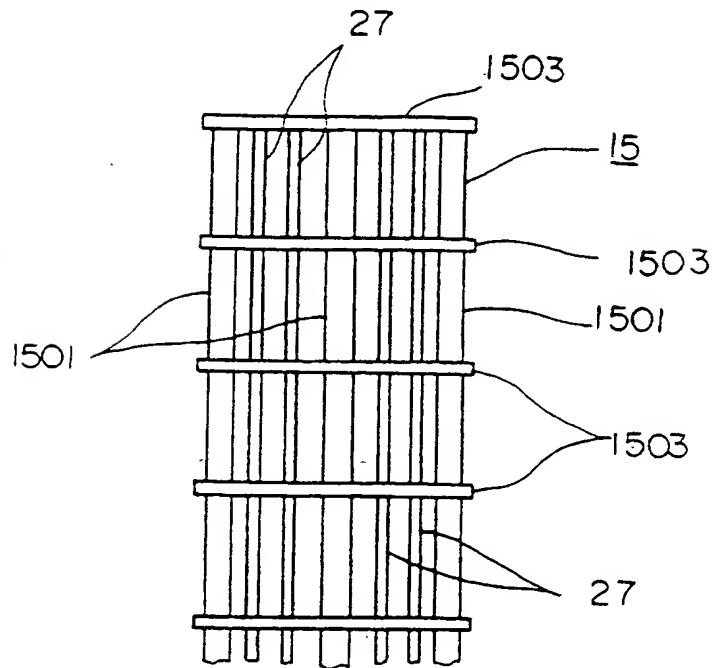


FIG. 5

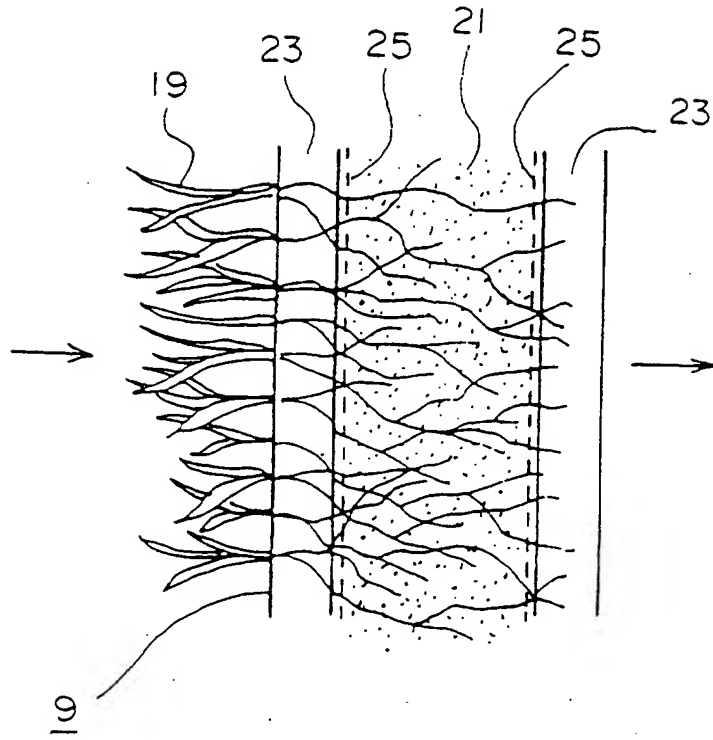


FIG. 6

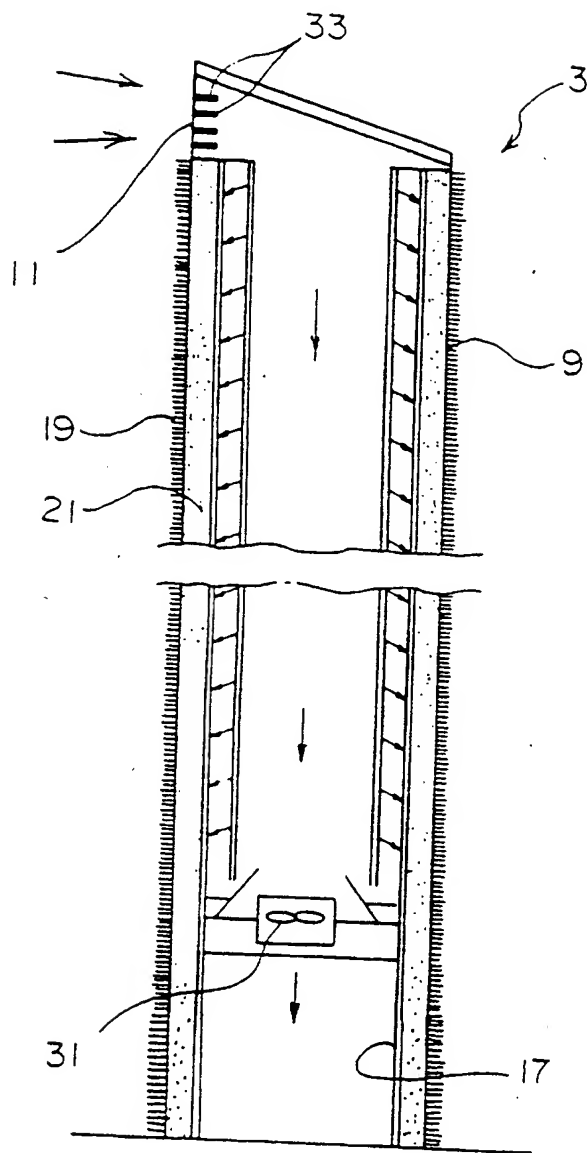




FIG. 7

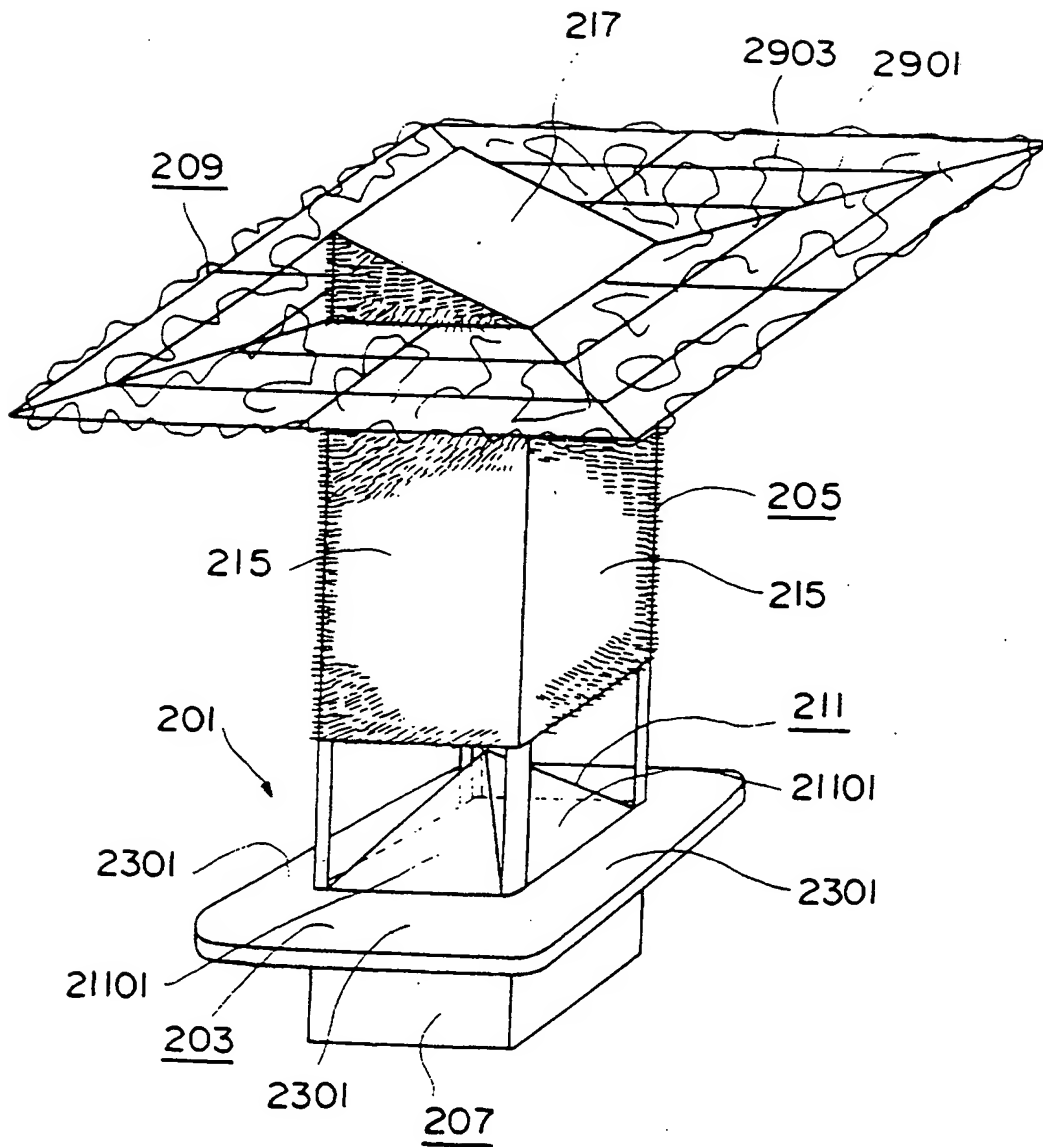


FIG. 8

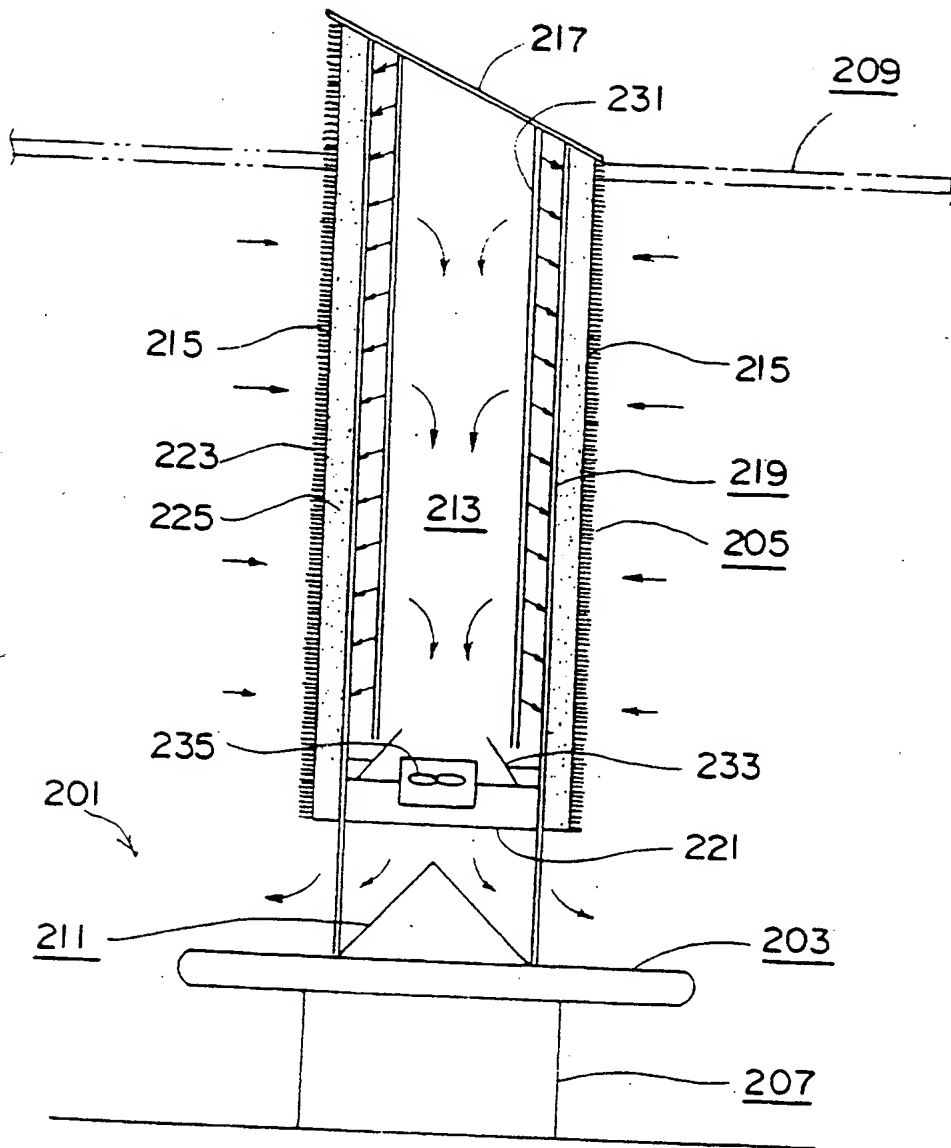


FIG. 9

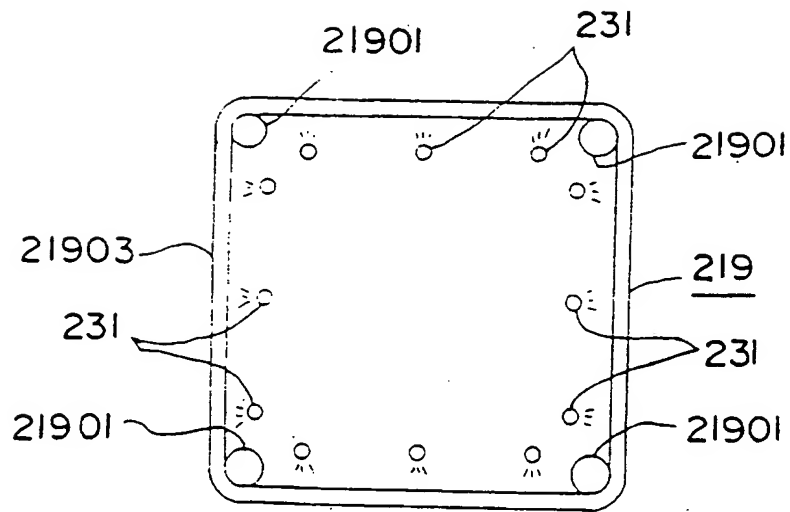


FIG. 10

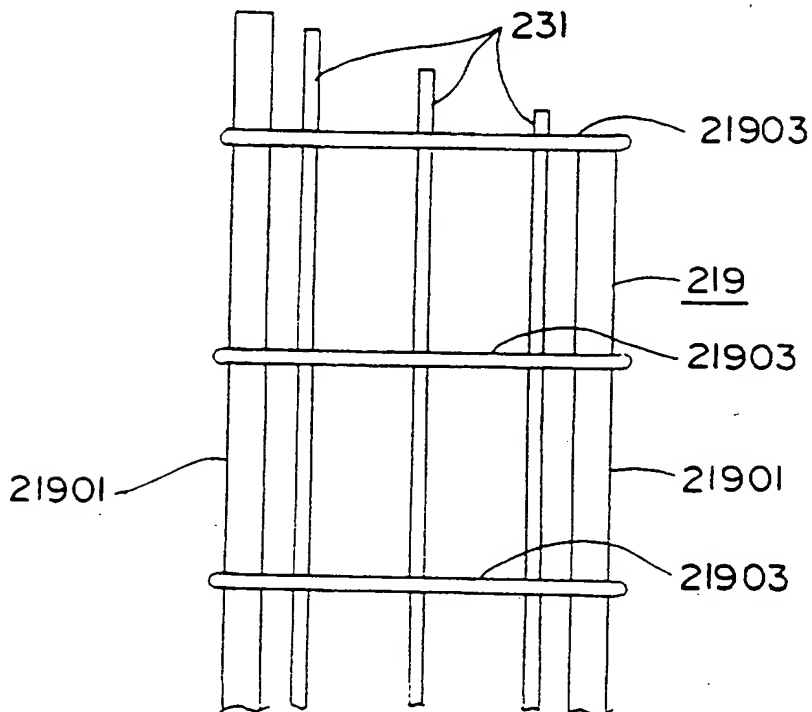


FIG. 11

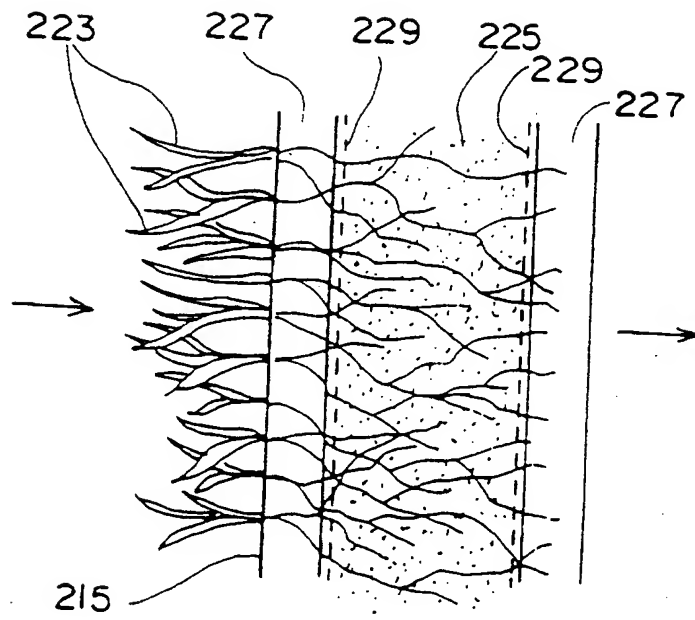


FIG. 12

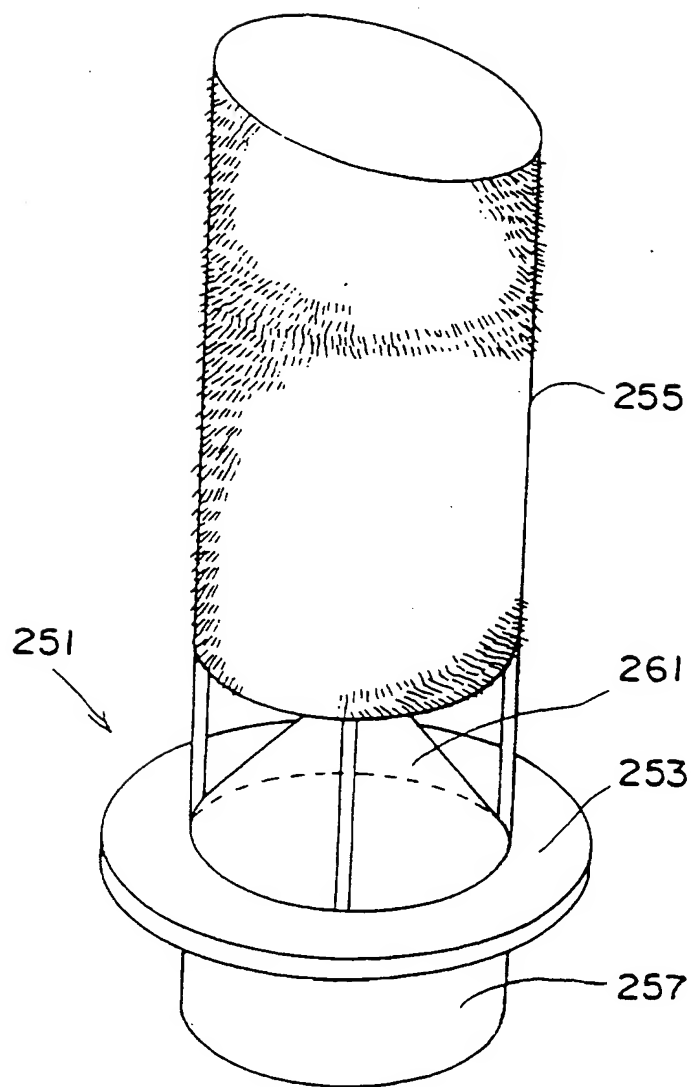


FIG. 13

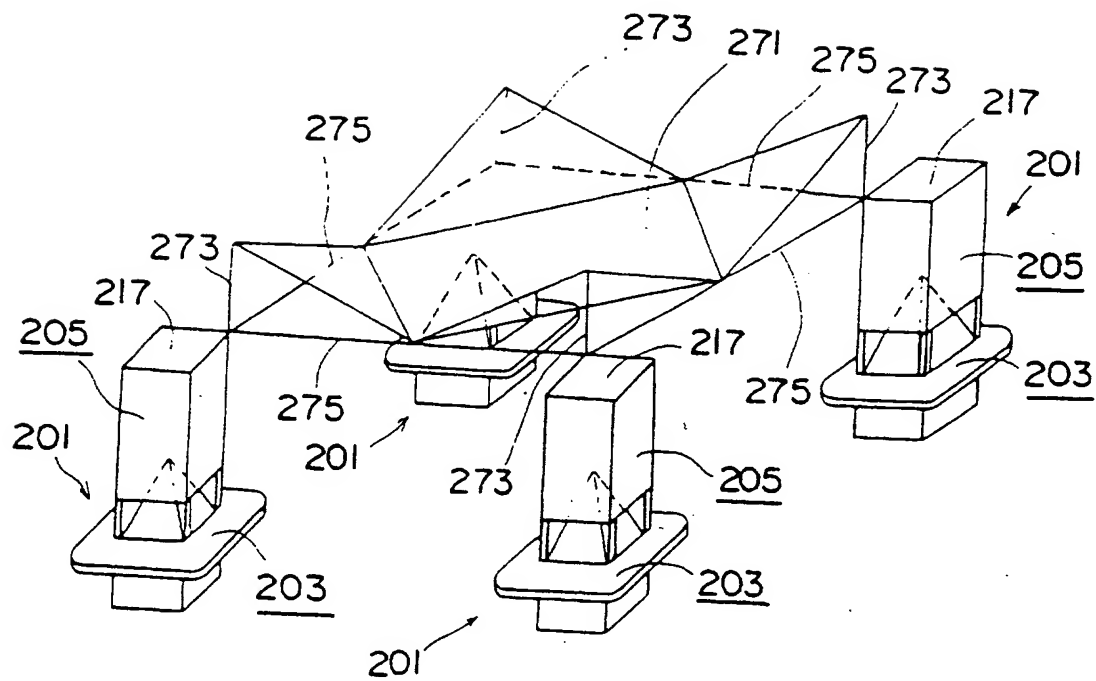


FIG. 14

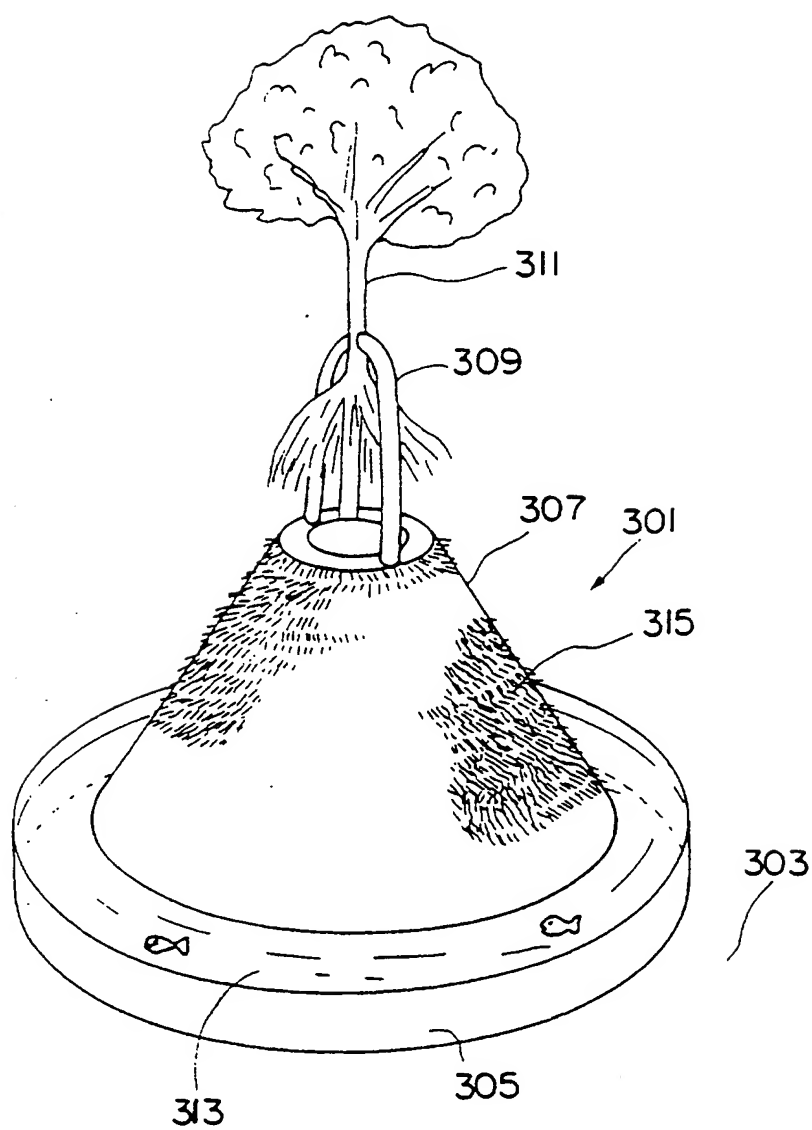






FIG. 16

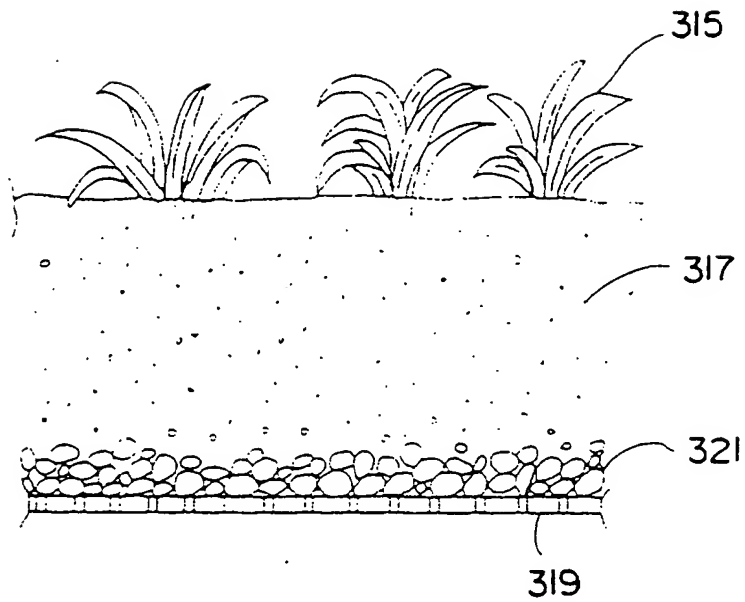


FIG. 17

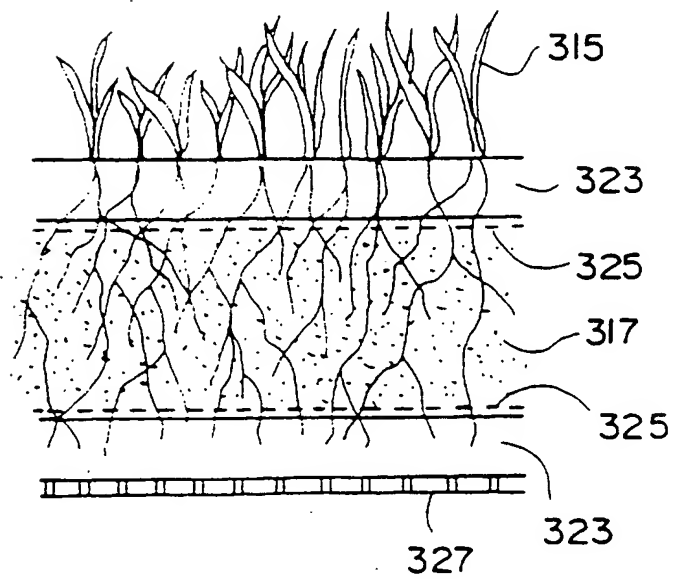


FIG. 18

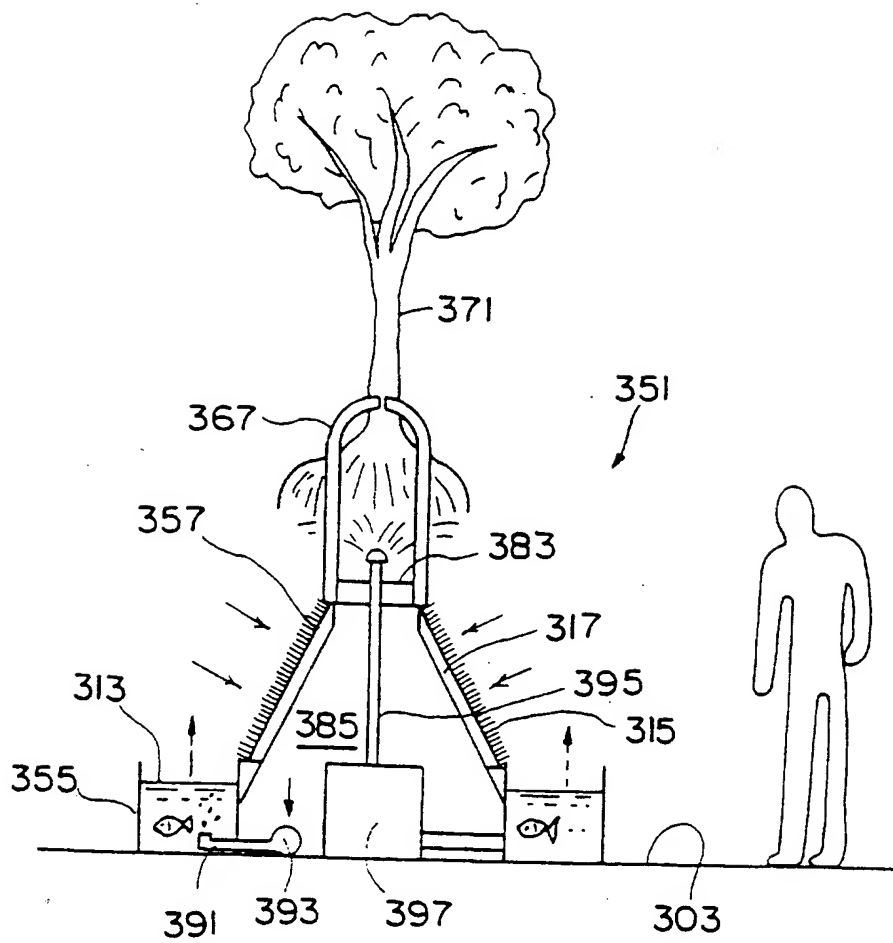


FIG. 19

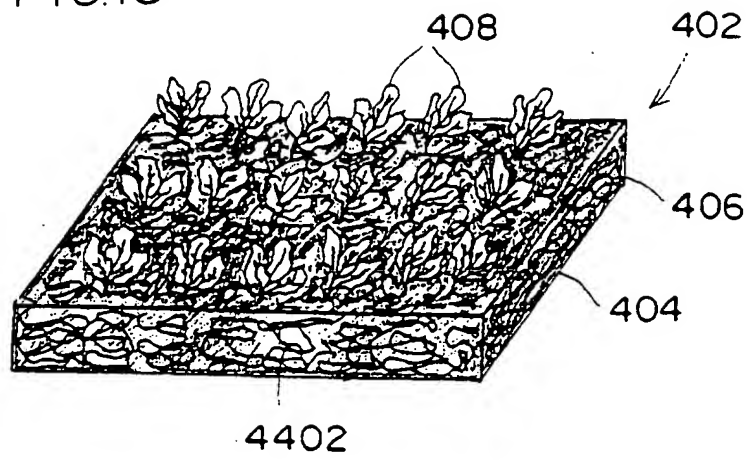


FIG. 20

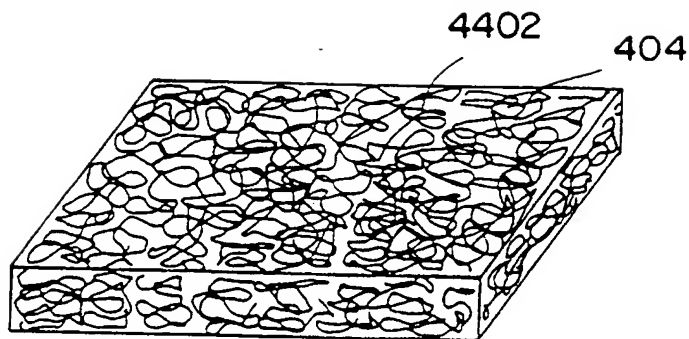


FIG. 21

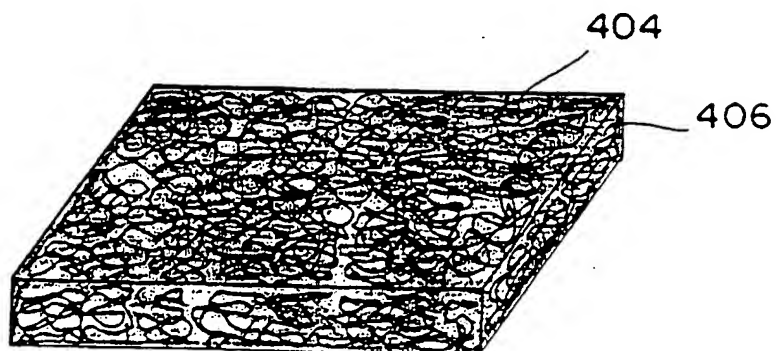


FIG. 22

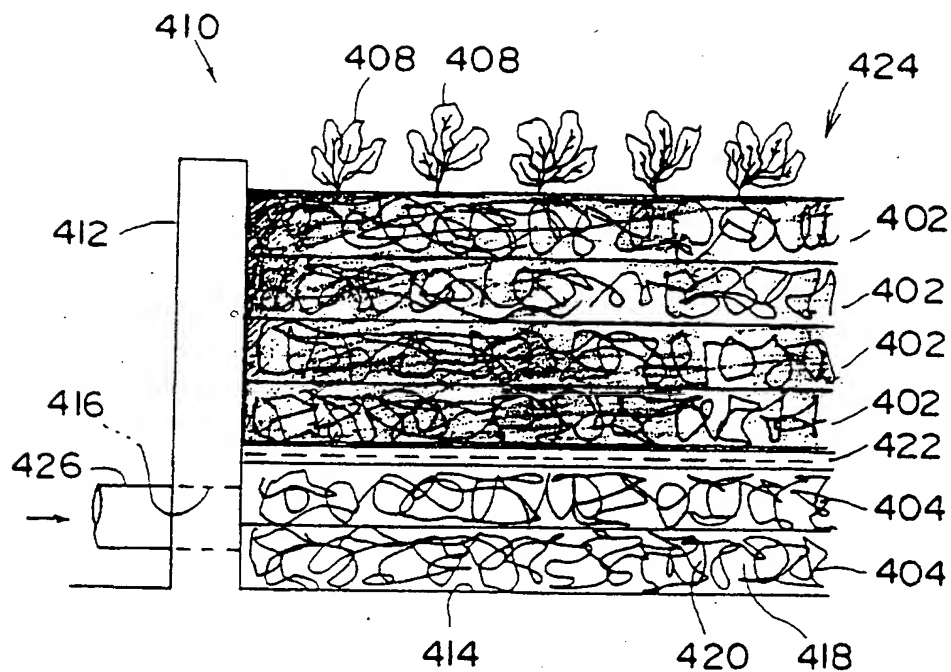


FIG. 23

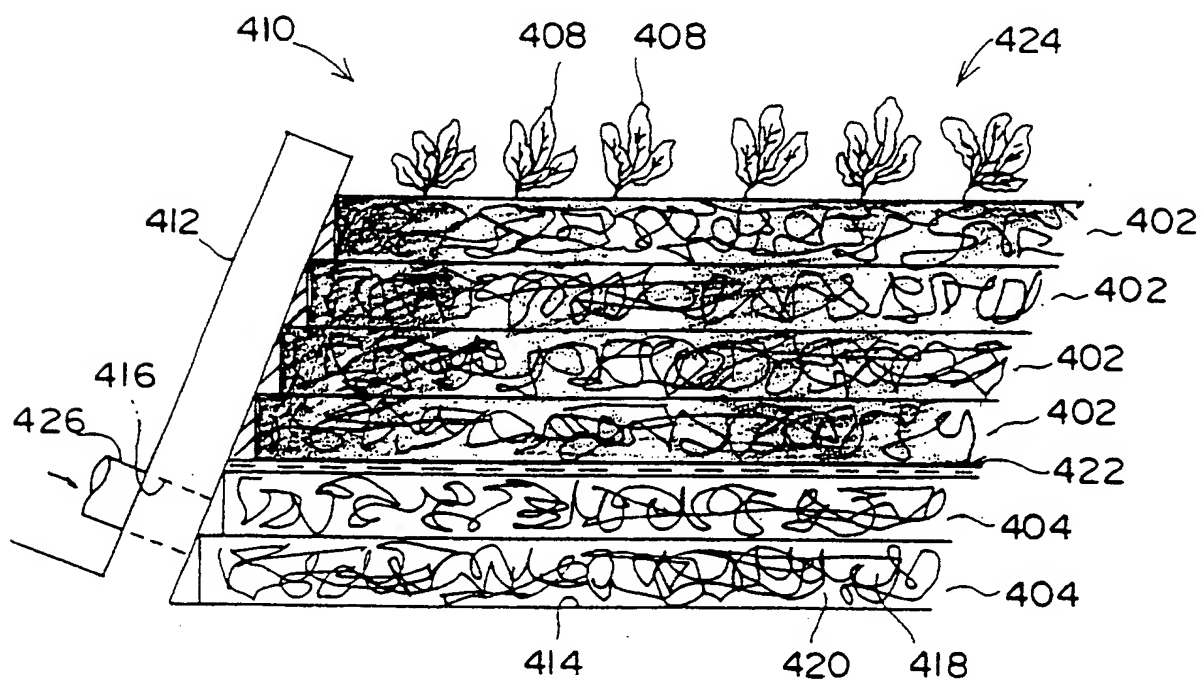


FIG. 24

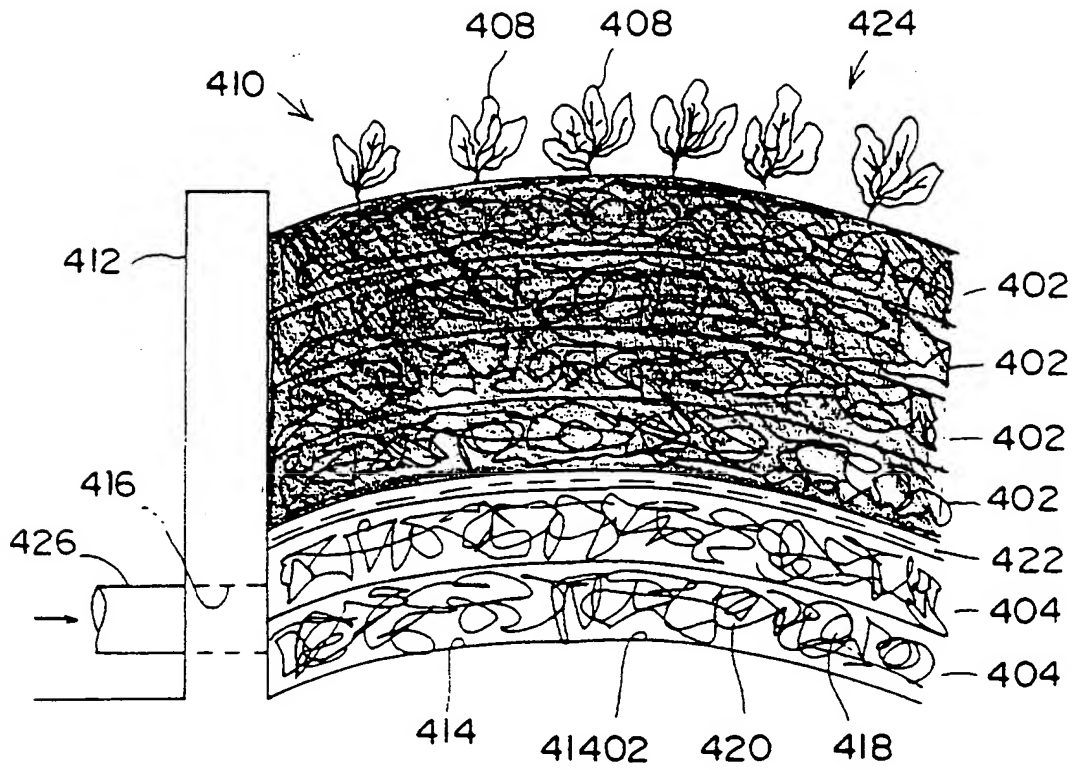
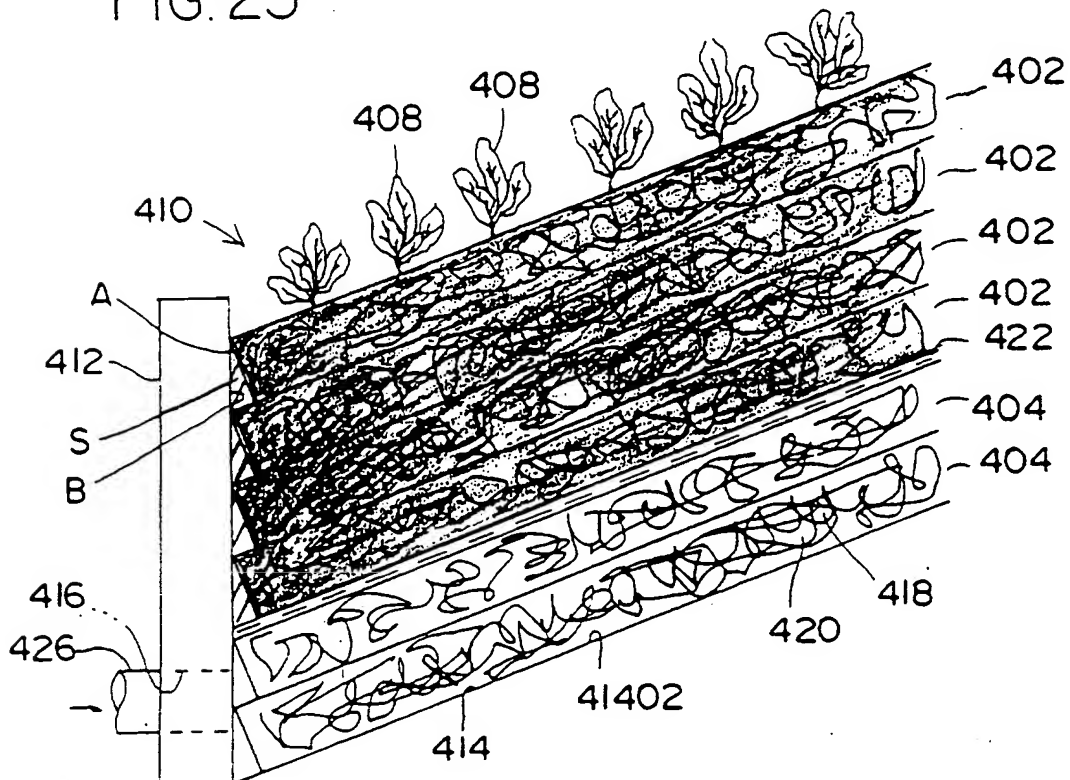


FIG. 25



## METHOD OF AND APPARATUS FOR PURIFYING CONTAMINATED AIR

## BACKGROUND OF THE INVENTION

## Field of the Invention:

The present invention relates to a method of and an apparatus for purifying contaminated air in the environmental atmosphere.

## Description of the Related Art:

There has been known a conventional method of purifying contaminated air in the environmental atmosphere by passing the contaminated air through a soil layer populated with microorganisms to allow the contaminants in the contaminated air to be degraded by the microorganisms in the soil layer. Such a purifying method and an apparatus for carrying out the method have proven much more satisfactory than traditional methods of and apparatus for purifying contaminated air. However, while a wide variety of potential applications may possibly be available for the existing method and apparatus, only some of them have been proposed so far in the art.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method of and an apparatus for purifying contaminated air in the environmental atmosphere by passing the contaminated air through a soil layer populated with microorganisms to allow the contaminants in the contaminated air to be degraded by the microorganisms in the soil layer, the method and the apparatus being improved so as to be applicable to a variety

of new applications.

According to the present invention, there is provided a method of purifying contaminated air, comprising the steps of providing a wall composed of a soil layer for being populated with microorganisms, the soil layer allowing air to pass therethrough, and supporting means supporting the soil layer, the supporting means allowing air to pass therethrough, and passing contaminated air through the wall. Plants may be cultivated on the soil layer. The supporting means may comprise a pair of soil holders disposed in sandwiching relation to the soil layer and a frame supporting the soil holders.

According to the present invention, there is also provided an apparatus for purifying contaminated air, comprising a hollow body having a side wall, an air outlet port defined in the hollow body for communicating between a space inside of the hollow body and a space outside of the hollow body, and air flowing means disposed in the hollow body for discharging air from the space inside of the hollow body through the air outlet port into the space outside of the hollow body, the side wall having at least a portion comprising a wall composed of a soil layer for being populated with microorganisms, the soil layer allowing air to pass therethrough, plants cultivated on the soil layer, and supporting means supporting the soil layer, the supporting means allowing air to pass therethrough.

According to the present invention, there is also

provided an apparatus for purifying contaminated air, comprising a slanted wall inclined with respect to a horizontal plane, the slanted wall comprising a soil layer for being populated with microorganisms, the soil layer allowing air to pass therethrough, plants cultivated on the soil layer, and supporting means supporting the soil layer, the supporting means allowing air to pass therethrough, air flowing means for flowing contaminated air transversely through the soil layer, a container positioned below the slanted wall and containing water, and water supply means for supplying the water contained in the container to the soil layer.

According to the present invention, there is further provided an air purifying soil unit comprising a soil holder composed of a meshwork having a high degree of porosity and resistant to loads and erosion, and a soil layer filled in the soil holder, the soil layer comprising a mixture of perlite, vermiculite, and peat moss.

According to the present invention, there is also provided a method of purifying contaminated air, comprising the steps of providing an air purifying soil unit comprising a soil holder composed of a meshwork having a high degree of porosity and resistant to loads and erosion, and a soil layer filled in the soil holder, the soil layer comprising a mixture of perlite, vermiculite, and peat moss, placing a mesh sheet on a bottom surface of the air purifying soil unit to prevent the soil layer from dropping off the soil holder, providing an air chamber underneath the mesh sheet, and in-



troducing contaminated air into the air chamber to pass the contaminated air upwardly through the air purifying soil unit for thereby purifying the contaminated air.

The above and other objects, features, and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawings which illustrate preferred embodiments of the present invention by way of example.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of an atelier which incorporates a plurality of contaminated air purifying apparatus according to a first embodiment of the present invention;

FIG. 2 is an enlarged fragmentary vertical cross-sectional view of one of the contaminated air purifying apparatus shown in FIG. 1;

FIG. 3 is a plan view of a frame of the contaminated air purifying apparatus shown in FIG. 1;

FIG. 4 is a fragmentary front elevational view of the frame shown in FIG. 3;

FIG. 5 is a fragmentary cross-sectional view of plants and a soil layer in the contaminated air purifying apparatus shown in FIG. 1;

FIG. 6 is an enlarged fragmentary vertical cross-sectional view of the contaminated air purifying apparatus shown in FIG. 1, with an air inlet port being open;

FIG. 7 is a perspective view of a bench which in-

corporates a contaminated air purifying apparatus according to a second embodiment of the present invention;

FIG. 8 is a front elevational view of the bench shown in FIG. 7 with a hollow body of the contaminated air purifying apparatus being shown in cross section;

FIG. 9 is a plan view of a frame of the contaminated air purifying apparatus shown in FIG. 7;

FIG. 10 is a fragmentary front elevational view of the frame shown in FIG. 9;

FIG. 11 is a fragmentary cross-sectional view of plants and a soil layer in the contaminated air purifying apparatus shown in FIG. 7;

FIG. 12 is a perspective view of a bench incorporating a modified contaminated air purifying apparatus;

FIG. 13 is a perspective view of benches incorporating other modified contaminated air purifying apparatus;

FIG. 14 is a perspective view of a pond assembly which incorporates a contaminated air purifying apparatus according to a third embodiment of the present invention;

FIG. 15 is a vertical cross-sectional view of the pond assembly shown in FIG. 14;

FIG. 16 is an enlarged fragmentary cross-sectional view of a soil section in the contaminated air purifying apparatus shown in FIG. 14;

FIG. 17 is an enlarged fragmentary cross-sectional view of a soil section in the contaminated air purifying apparatus shown in FIG. 14;

FIG. 18 is a vertical cross-sectional view of a pond assembly incorporating a modified contaminated air purifying apparatus;

FIG. 19 is a perspective view of an air purifying soil unit according to a fourth embodiment of the present invention;

FIG. 20 is a perspective view of a soil holder of the air purifying soil unit shown in FIG. 19;

FIG. 21 is a perspective view of the soil holder filled with a soil layer;

FIG. 22 is a cross-sectional view illustrative of an air purifying structure according to the present invention which employs the air purifying soil unit shown in FIG. 19;

FIG. 23 is a cross-sectional view illustrative of another air purifying structure according to the present invention which employs the air purifying soil unit shown in FIG. 19;

FIG. 24 is a cross-sectional view illustrative of still another air purifying structure according to the present invention which employs the air purifying soil unit shown in FIG. 19; and

FIG. 25 is a cross-sectional view illustrative of yet still another air purifying structure according to the present invention which employs the air purifying soil unit shown in FIG. 19.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[1st Embodiment]

FIG. 1 shows an atelier which incorporates a plurality of contaminated air purifying apparatus according to a first embodiment of the present invention, and FIG. 2 is a fragmentary vertical cross-sectional view of one of the contaminated air purifying apparatus shown in FIG. 1.

As shown in FIG. 1, an atelier 1 has four contaminated air purifying apparatus 3 positioned at respective corners of a square on a floor 1A of the atelier 1.

Each of the contaminated air purifying apparatus 3 has a cylindrical tower or hollow body 5 standing vertically on the floor 1A. The tower 5 has a space or chamber 7 defined therein, and comprises a tubular outer wall 9 extending vertically upwardly to a certain height, an air inlet port 11 defined laterally in an upper end of the outer wall 9, a top panel 13 closing the upper end of the outer wall 9, a frame 15 positioned inside and supporting the outer wall 9, and an air outlet port 17 defined laterally in a lower end of the outer wall 9.

As shown in FIGS. 3 and 4, the frame 15 comprises a plurality of vertical pipes 1501 circumferentially spaced at certain intervals, and a plurality of horizontal annular pipes 1503 vertically spaced at intervals and disposed around the vertical pipes 1501.

As shown in FIG. 5, the outer wall 9 comprises a soil layer 21 on which plants 19 are cultivated and which can be populated with microorganisms, the soil layer 21 allowing air to flow from outside of the tower 5 into the tower 5, and

a support means for supporting the soil layer 21.

The plants 19 may be any plants which are grown densely to a relatively low height, and include lawn grass, ivies, pasture grass, or the like.

The soil layer 21 comprises a layer of soil for populating microorganisms therein, e.g., a layer of andosols mixed with perlite and so on for a high degree of porosity or voidage so that air can flow from outside of the tower 5 through the soil layer 21 into the tower 5.

The soil layer 21 is placed in position as follows:

First, a finely porous sheet 23 of nonwoven fabric, rock wool, or the like, on the outer side of which the plants 19 are to be cultivated, is positioned, and then a net 25 for supporting the sheet 23 is placed on the inner side of the sheet 23. The soil layer 21 is disposed on the inner side of the net 25, and another net 25 is placed on the inner side of the soil layer 21. Another finely porous sheet 23 of nonwoven fabric, rock wool, or the like is positioned on the inner side of the net 25.

The nets 25 between which the soil layer 21 is sandwiched are attached to the frame 15. The soil layer 21 is thus vertically held in place, constituting the outer wall 9. The sheets 23, the nets 25, and the frame 15 serve as the support means for supporting the soil layer 21, and the sheets 23 and the nets 25 jointly serve as a soil holder.

The plants 19 are not grown on the soil layer 21 while it is being vertically held between the sheets 23 and

the nets 25. Instead, the plants 19 are first hydroponically grown on the soil layer 21 while it is being horizontally held between the sheets 23 and the nets 25.

After the plants 19 have grown, the soil layer 21 sandwiched between the sheets 23 and the nets 25 is cut off into smaller areas, which are transferred to the tower 5 and vertically attached to the frame 15. Upon being vertically attached to the frame 15, the soil layer 21 is firmly held between the sheets 23 and the nets 25 and retained in position by the roots of the plants 19.

The soil layer 21 and the plants 19 may be attached to the frame 15 in any of various ways. For example, the frame 15 may be circumferentially divided into sections, and the plants 19 may be grown on the sections that are held substantially horizontally. After the plants 19 have grown, the sections may be vertically assembled into the frame 15. The plants 19 can be grown better when they are grown on the soil layer 21 that is first placed horizontally than on the soil layer 21 that is first placed vertically.

Water supply pipes (water supply means) 27 are disposed inside of the frame 15.

The water supply pipes 27 are circumferentially spaced inside of the frame 15, and each have a plurality of vertically spaced holes for ejecting water to the inner sheet 23 to supply the water to the soil layer 21. The water supply pipes 27 are supplied with water from a tank (not shown) by a pump (not shown).

An annular water receptacle 29 is positioned inwardly of the lower end of the frame 15 for receiving excessive water that has been supplied to the soil layer 21. The water received by the annular water receptacle 29 is returned to the tank. The soil layer 21 may be supplied with water at all times or periodically. The water supply pipes 27 may be dispensed with, and the operator may manually supply water to the soil layer 21.

A fan (air flowing means) 31 for flowing air in the space 7 downwardly is disposed in a space defined in the annular water receptacle 29.

The top panel 13 comprises a solar panel which has solar cells. In this embodiment, the fan 31 and the pump are actuated by the electric energy which is generated by the solar cells of the top panel 13. Alternatively, the fan 31 and the pump may be actuated by a commercial power supply.

A number of swingable louvers 33 are disposed in the air inlet port 11 for selectively opening and closing the air inlet port 11.

Operation of each of the contaminated air purifying apparatus 3 will be described below.

When the fan 31 is actuated, it discharges air in the space 7 from the tower 5 through the air outlet port 17 into the atelier 1. As the air is discharged from the tower 5, contaminated air in the atelier 1 is drawn through the soil layer 21 into the tower 5.

When the air passes through the soil layer 21, the

soil layer 21 performs a physical action as a filter to trap dust particles and adsorbs impurities such as a hydrocarbon gas such as methane or the like.

The microorganisms contained in the soil layer 21 degrade or decompose those impurities or noxious gases.

Specifically, aerobic microorganisms are populated on the surface of the soil layer 21 and in regions of the soil layer 21 where air flows, and anaerobic microorganisms are populated in regions of the soil layer 21 where no air flows. When the contaminated air is consumed or inhaled by the microorganisms, the microorganisms chemically transform or degrade various contaminant gases in the contaminated air, e.g., carbon monoxide into carbon dioxide, nitrogen monoxide into nitrate ions, and methane into carbon dioxide and water. In this manner, various contaminants contained in the contaminated air are removed by the soil layer 21.

Clean air from which the contaminants have been removed is then returned from the air outlet port 17 into the atelier 1.

Since the contaminated air purifying apparatus 3 purifies contaminated air with the plants 19 and the soil layer 21, as described above, it is not necessary to install any dedicated air purifiers which would impair the appearance of the atelier 1. The contaminated air purifying apparatus 3 may easily be designed to be analogous in appearance to a columnar plant or flower bed, and hence can be installed in the atelier 1 without making the atelier 1 unsightly in ap-



pearance. The contaminated air purifying apparatus 3 may be installed in any desired size or number for sufficiently purifying air in a large space.

The tower 5 is vertically elongate, and the soil layer 21 is supplied with water from the water supply pipes 27. In summer, the air inlet port 11 is closed, as shown in FIG. 2, and when contaminated air passes through the soil layer 21, the water supplied to the plants 19 and the soil layer 21 is evaporated and deprives the air of heat. Therefore, cool air is introduced into the tower 5, and hence discharged from the air outlet port 17. The contaminated air purifying apparatus 3 may thus serve as an air conditioning unit.

In winter, the louvers 33 are turned to open the air inlet port 11, as shown in FIG. 6, and warm air can be discharged from the air outlet port 17 because air near the ceiling of the atelier 1 is warmer than air near the floor of the atelier 1 and such warm air is introduced through the air inlet port 11 into the tower 5. The contaminated air purifying apparatus 3 may thus serve as a heater.

When the contaminated air purifying apparatus 3 is used as an air conditioning unit, it is preferable for the fan 31 to deliver more air or to have more vanes or blades than when the contaminated air purifying apparatus 3 is used as a heater because contaminated air needs to be forcibly passed through the soil layer 21.

In this embodiment, the air outlet port 17 is de-

defined in the lower end of the tower 5. However, the air outlet port 17 may be defined in a vertically intermediate region of the tower 5. In such a modification, the lower end of the tower 5 may be closed, and the fan 31 may be disposed in the air outlet port 17 defined in the vertically intermediate region of the tower 5.

While the tower 5 is of a cylindrical shape in this embodiment, it may be of a rectangular parallelepiped, conical, or pyramidal shape.

In the illustrated embodiment, the tower 5 stands vertically and is elongate vertically. However, the tower 5 may extend horizontally and may be elongate horizontally. Such a modified tower may have an air outlet port defined in a horizontally central region thereof or in one or both longitudinal ends thereof.

The outer wall 9 composed of the plants 19 and the soil layer 21 may be positioned on a portion of the circumferential surface of the tower 5, rather than on the entire circumferential surface of the tower 5.

In the above embodiment, contaminated air in the atelier 1 is drawn through the soil layer 21 from the outer side to the inner side thereof into the space 7, and clean air is discharged from the air outlet port 17 into the atelier 1. However, the air flow may be reversed by drawing contaminated air in the atelier 1 through the air outlet port 17 into the space 7, passing the contaminated air through the soil layer 21 from the inner side to the outer side thereof,

and discharging clean air from the outer side of the soil layer 21.

The contaminated air purifying apparatus 3 employs the hollow tower 5 in the above embodiment. However, the principles of the present invention are also applicable to a contaminated air purifying apparatus which does not employ a hollow tower, but a wall member of a certain area which is composed of a vertically and horizontally extending soil layer 21 on which plants 19 are cultivated and which is populated with microorganisms, and contaminated air may be purified by passing through such a wall. For example, if the present invention is applied to the purification of air inside a building, a wall member of a certain area which is composed of a soil layer 21 supported in a vertical plane by a support may be disposed in front of an air inlet opening that is defined in a wall of the building, and air from outside of the building may be purified by passing through the wall member.

The principles of the present invention may be applied anywhere inside or outside of buildings. For example, the contaminated air purifying apparatus 3 may be installed outdoors such as in an outdoor space, a park, an open space near a skyscraper, or the like.

A contaminated air purifying apparatus according to a second embodiment of the present invention will be described below.

FIG. 7 shows in perspective a bench 201 which in-

corporates the contaminated air purifying apparatus according to the second embodiment of the present invention.

As shown in FIG. 7, the bench 201 comprises a seat 203, a hollow body 205, a rectangular base 207 which supports the seat 203 and the hollow body 205, and a sunshade 209 disposed on an upper portion of the hollow body 205.

The seat 203 is of a frame shape composed of four plates 2301 jointly making up an outer edge portion of a square. The plates 2301 have arcuate outer corners.

A pyramidal air guide 211 projects upwardly from the center of the bench 201 which is surrounded by the four plates 2301 and has four triangular guide surfaces 21101 facing the respective plates 2301.

The plates 2301 are supported on the base 7 such that they lie substantially horizontally at a height suitable for people to be seated thereon. The plates 2301, the base 207, and the air guide 211 are formed integrally with each other of concrete or the like, for example.

FIG. 8 shows in front elevation of the bench 201 with the hollow body 205 shown in cross section.

As shown in FIG. 8, the hollow body 205 is of a rectangular parallelepiped in shape and has a space 213 defined therein. The hollow body 205 comprises four side walls 215 extending vertically to a predetermined height, a top panel 217 closing the upper ends of the side walls 215 and slanted toward south, and a frame 219 disposed inside of the side walls 215 and supporting the side walls 215. The side

walls 215 have respective lower ends positioned above the plates 2301 of the seat 203, and the lower end of the hollow body 205 which is surrounded by the side walls 215 is open, defining an air outlet port 221.

As shown in FIGS. 9 and 10, the frame 219 comprises four horizontally spaced vertical pipes 21901 assembled in a frame of a rectangular parallelepiped, and a plurality of vertically spaced horizontal pipes 21903 disposed around the vertical pipes 21901. The vertical pipes 21901 have heights progressively smaller to match the gradient of the top panel 217.

As shown in FIG. 11, each of the side walls 215 comprises a soil layer 225 on which plants 223 are cultivated and which can be populated with microorganisms, the soil layer 225 allowing air to flow from outside of the hollow body 205 into the hollow body 205, and a support means for supporting the soil layer 225.

The plants 223 may be any plants which are grown densely to a relatively low height, and include lawn grass, ivies, pasture grass, or the like.

The soil layer 225 comprises a layer of soil for populating microorganisms therein, e.g., a layer of andosols mixed with perlite and so on for a high degree of porosity or voidage so that air can flow from outside of the hollow body 205 through the soil layer 225 into the hollow body 205.

The soil layer 225 is placed in position as follows:

First, a finely porous sheet 227 of nonwoven fabric, rock wool, or the like, on the outer side of which the plants 223 are to be cultivated, is positioned, and then a net 229 for supporting the sheet 227 is placed on the inner side of the sheet 227. The soil layer 225 is disposed on the inner side of the net 229, and another net 229 is placed on the inner side of the soil layer 225. Another finely porous sheet 227 of nonwoven fabric, rock wool, or the like is positioned on the inner side of the net 229.

The nets 229 between which the soil layer 225 is sandwiched are attached to the frame 219. The soil layer 225 is thus vertically held in place, constituting each side wall 215. The sheets 227, the nets 229, and the frame 219 serve as the support means for supporting the soil layer 225, and the sheets 227 and the nets 229 jointly serve as a soil holder.

The plants 223 are not grown on the soil layer 225 while it is being vertically held between the sheets 227 and the nets 229. Instead, the plants 223 are first hydroponically grown on the soil layer 225 while it is being horizontally held between the sheets 227 and the nets 229.

After the plants 223 have grown, the soil layer 225 sandwiched between the sheets 227 and the nets 229 are cut off into smaller areas, which are transferred to the hollow body 205 and vertically attached to the frame 219. Upon being vertically attached to the frame 219, the soil layer 225 is firmly held between the sheets 227 and the nets 229 and re-

tained in position by the roots of the plants 223.

The soil layer 225 and the plants 223 may be attached to the frame 219 in any of various ways. For example, the frame 219 may be circumferentially divided into sections, and the plants 223 may be grown on the sections that are held horizontally. After the plants 223 have grown, the sections may be vertically assembled into the frame 219. The plants 223 can be grown better when they are grown on the soil layer 225 that is first placed horizontally than on the soil layer 225 that is first placed vertically.

Water supply pipes (water supply means) 231 are disposed inside of the frame 219.

The water supply pipes 231 are circumferentially spaced inside of the frame 219, and each have a plurality of vertically spaced holes for ejecting water to the inner sheet 227 to supply the water to the soil layer 225. The water supply pipes 231 are supplied with water from a tank (not shown) by a pump (not shown).

An annular water receptacle 233 is positioned inwardly of the lower end of the frame 219 for receiving excessive water that has been supplied to the soil layer 225. The water received by the annular water receptacle 233 is returned to the tank. The soil layer 225 may be supplied with water at all times or periodically. The water supply pipes 231 may be dispensed with, and the operator may manually supply water to the soil layer 225.

A fan (air flowing means) 235 for flowing air in

the space 213 downwardly is disposed in a space defined in the annular water receptacle 233.

The fan 235 may be actuated at all times, or may be actuated for a certain period of time based on a signal from a sensor while a person is sitting on the seat 203 or approaches the bench 201.

The top panel 217 comprises a solar panel which has solar cells. In this embodiment, the fan 235 and the pump are actuated by the electric energy which is generated by the solar cells of the top panel 217. Alternatively, the fan 235 and the pump may be actuated by a commercial power supply.

The sunshade 209 comprises a frame 2901 of wood extending horizontally and attached to the upper end of the hollow body 205, and plants 2903 such as ivies twining about the frame 2901.

The contaminated air purifying apparatus according to the second embodiment of the present invention operates as follows:

The bench 201 is placed on a floor of a building or a concrete surface of an outdoor space or the like, and the base 207 is anchored to the floor or the concrete surface by bolts or the like.

When the fan 235 is actuated, air in the space 213 flows downwardly through the air outlet port 221, and is guided by the guide surfaces 21101 of the air guide 211 toward the plates 2301 of the seat 203. Contaminated air around the bench 201 is therefore drawn through the soil



layer 225 from its outer side into the hollow body 205.

When the contaminated air passes through the soil layer 225, the soil layer 225 filters the contaminated air to remove contaminants therefrom in the same manner as with the first embodiment, and clean air is discharged from the air outlet port 221 onto the plates 2301 of the seat 203 and returned into the building or the atmosphere.

The contaminated air purifying apparatus combined with the bench 201 may easily be designed to be analogous in appearance to a plant or flower bed in the shape of a rectangular parallelepiped. Therefore, the bench 201 can be given a high practical or commercial value, and hence can be installed without making the surrounding area unsightly in appearance.

Since the hollow body 205 purifies ambient contaminated air, clean air is always present at least in the vicinity of the bench 201. Therefore, those people who sit on the bench 201 are supplied with clean air, which makes them feel highly at rest or comfortable.

Consequently, the contaminated air purifying apparatus combined with the bench 201 is highly effective to contribute to the achievement of better environmental conditions.

The hollow body 205 is vertically elongate, and the soil layer 225 is supplied with water from the water supply pipes 231. In summer, when contaminated air passes through the soil layer 225, the water supplied to the plants 223 and

the soil layer 225 is evaporated and deprives the air of heat. Therefore, cool air is introduced into the hollow body 205, and hence discharged from the air outlet port 221. The contaminated air purifying apparatus may thus serve as an air conditioning unit. The bench 201 is highly practical in summer as it gives persons resting thereon cool and clean air supplied from within the hollow body 205.

A modified contaminated air purifying apparatus according to the present invention will be described below with reference to FIG. 12.

As shown in FIG. 12, the modified contaminated air purifying apparatus is combined with a bench 251 which comprises an annular seat 253, a cylindrical base 257, a cylindrical hollow body 255, and a conical air guide 261, and has no sunshade. The other details of the modified contaminated air purifying apparatus are identical to those of the contaminated air purifying apparatus according to the second embodiment shown in FIG. 7, and the modified contaminated air purifying apparatus operates in the same manner and offers the same advantages as the contaminated air purifying apparatus shown in FIG. 7.

FIG. 13 shows benches incorporating other modified contaminated air purifying apparatus.

As shown in FIG. 13, a plurality of spaced benches 201 are associated with respective modified contaminated air purifying apparatus each essentially identical to the contaminated air purifying apparatus according to the second embod-

iment shown in FIG. 7 except that a top panel 217 lies horizontally and no sunshade is employed. A tent 271 is supported by and placed over the benches 201 to provide a relatively wide sunshade area.

Pipes 273 project upwardly from the respective hollow bodies 205 of the modified contaminated air purifying apparatus, and joint pipes 275 are coupled between the pipes 273. The tent 271 extends between and is supported by upper ends of the pipes 273 and intermediate points of the joint pipes 275.

The modified contaminated air purifying apparatus shown in FIG. 13 operate in the same manner and offer the same advantages as the contaminated air purifying apparatus shown in FIG. 7, and offer an additional advantage because the tent 271 produces a relatively wide sunshade area to give people a large rest place especially under intensive sunlight in summer.

In the second embodiment and its modifications, the air outlet port 221 is defined in the lower end of the hollow body 205, 255. However, the air outlet port 221 may be defined in an vertically intermediate region of the hollow body 205, 255. In such a modified arrangement, the lower end of the hollow body 205, 255 may be closed, and the fan 235 may be disposed in the air outlet port 221 defined in the vertically intermediate region of the hollow body 205, 255.

While the hollow body 205, 2555 is of a rectangular parallelepiped or cylindrical shape in the second embodiment

and its modifications, it may be of a conical, pyramidal, or egg shape.

In the illustrated second embodiment and its modifications, the hollow body 205, 255 stands vertically and is elongate vertically. However, the hollow body 205, 255 may extend horizontally and may be elongate horizontally, and may be designed freely or to match the configuration of the seat 203.

The side wall 215 composed of the plants 223 and the soil layer 225 may be positioned on a portion of the wall surface of the hollow body 205, 255, rather than on the entire side surface of the hollow body 205, 255.

In the above second embodiment and its modifications, contaminated air is drawn through the soil layer 225 from the outer side to the inner side thereof into the space 213, and clean air is discharged from the air outlet port 221. However, the air flow may be reversed by drawing contaminated air through the air outlet port 221 into the space 213, passing the contaminated air through the soil layer 225 from the inner side to the outer side thereof, and discharging clean air from the outer side of the soil layer 225.

A contaminated air purifying apparatus according to a third embodiment of the present invention will be described below.

FIG. 14 shows in perspective view a pond assembly which incorporates the contaminated air purifying apparatus according to the third embodiment of the present invention,

and FIG. 15 shows the pond assembly in vertical cross section.

A pond assembly 301, which may be placed on a surface 303 such as a floor of a building or a concrete surface of an outdoor space or the like, comprises an annular container 305 placed on the surface 303, a conical slanted wall 307 projecting upwardly and positioned within the annular container 305, and a tree 311 supported in an erected condition by a portal post 309 mounted on an upper end of the slanted wall 307. The container 305 contains water 313 with fish therein.

As shown in FIGS. 16 and 17, the slanted wall 307 comprises a soil layer 317 on which plants 315 are cultivated and which can be populated with microorganisms, the soil layer 317 allowing air to flow therethrough, and a support means for supporting the soil layer 317.

The plants 315 may be any plants which are grown densely to a relatively low height, and include lawn grass, ivies, pasture grass, or the like.

The soil layer 317 comprises a layer of soil for populating microorganisms therein, e.g., a layer of andosols mixed with perlite and so on for a high degree of porosity or voidage so that air can flow through the soil layer 317.

The soil layer 317 is placed in position according to either of first, second, and third processes as follows:

According to the first process, as shown in FIG. 16, a gravel layer 321 composed of broken stones is placed on

a grid frame 319, and the soil layer 317 is placed on the gravel layer 321. The frame 319 serves as the supporting means for supporting the soil layer 317.

According to the second process, as shown in FIG. 17, a finely porous sheet 323 of nonwoven fabric, rock wool, or the like, on the upper side of which the plants 315 are to be cultivated, is positioned, and then a net 325 for supporting the sheet 323 is placed on the lower side of the sheet 323. The soil layer 317 is disposed underneath the net 325, and another net 325 is placed on the lower side of the soil layer 317. Another finely porous sheet 323 of nonwoven fabric, rock wool, or the like is positioned underneath the net 325.

The nets 325 between which the soil layer 317 is sandwiched are attached to a grid frame 327. The soil layer 317 is thus obliquely held in place, constituting the wall 307. The sheets 323, the nets 325, and the frame 327 serve as the support means for supporting the soil layer 317, and the sheets 323 and the nets 325 jointly serve as a soil holder.

According to the second process, the plants 317 can be grown on the soil layer 317 while it is being held substantially horizontally. Specifically, the plants 317 are first hydroponically grown on the soil layer 317 while it is being horizontally held between the sheets 323 and the nets 325.

After the plants 315 have grown, the soil layer 317

sandwiched between the sheets 323 and the nets 325 is cut off into smaller areas, which are attached to the frame 327 that is slanted. Upon being attached to the frame 327, the soil layer 317 is firmly held between the sheets 323 and the nets 325 and retained in position by the roots of the plants 315.

According to the third process, the frame 327 is circumferentially divided into sections, and the plants 315 are grown on the sections that are held substantially horizontally. After the plants 315 have grown, the sections are assembled into an annular frame configuration. In the third process, the plants 317 can be grown well on the soil layer 317 that is placed substantially horizontally.

As shown in FIG. 15, a partition 331 is disposed below the slanted wall 307, and the slanted wall 307 has an annular top panel 333 on which the portal post 309 is mounted. The annular top panel 333, the partition 331, and the slanted wall 307 jointly define an annular space 335 positioned inside of the slanted wall 307.

The partition 331 comprises a cylindrical vertical central wall 33101 positioned centrally in the slanted wall 307, and an annular horizontal bottom wall 33103 extending from the lower end of the vertical central wall 33101 obliquely downwardly toward an inner side surface of the container 305. The horizontal bottom wall 33103 has an outer peripheral edge positioned above an inner circumferential edge of the container 305.

The vertical central wall 33101 has a plurality of

circumferentially spaced openings 337 defined therein, and a plurality of fans 339 are disposed respectively in the openings 337. When the fans 339 are actuated, air around the top panel 333 is drawn in and flows through a space in the cylindrical vertical central wall 33101 and the openings 337 into the annular space 335.

A water supply pipe 341 extends vertically in the space in the vertical central wall 33101 and has a lower portion bent horizontally and connected to a pump 343 which has a water inlet positioned underwater in the container 305. The water supply pipe 341 has its upper end fitted with a mist fitting. When the pump 343 is actuated, the water 313 in the container 305 is forced upwardly through the water supply pipe 341, and sprayed as a mist from the mist fitting over roots 31101 of the tree 311 and the plants 315.

Excessive water ejected from the mist fitting flows down the slanted wall 307 or the bottom wall 33103 back into the container 305.

Therefore, the water 313 in the container 305 is used as pond water and also as water to be supplied to the tree 311 and the plants 315.

The container 305 serves as a pond and also as a receptacle for receiving excessive water ejected from the mist fitting.

Operation of the contaminated air purifying apparatus shown in FIG. 15 will be described below.

When the fan 339 is actuated, contaminated air



around the top panel 333 flows through the space in the vertical central wall 33101 and the openings 337 into the space 335, passes through the soil layer 317 from its lower surface, and is discharged from the upper surface of the soil layer 317 into the building or the atmosphere.

When the contaminated air passes through the soil layer 317, the soil layer 317 filters the contaminated air to remove contaminants therefrom in the same manner as with the first embodiment, and clean air is discharged from the slanted wall 307 and returned into the building or the atmosphere.

The contaminated air purifying apparatus combined with the pond assembly 301 may easily be designed to be analogous in appearance to a plant or flower bed combined with a pond. Therefore, the pond assembly 301 can be given a high practical or commercial value, and hence can be installed without making the surrounding area unsightly in appearance.

Since the slanted wall 307 purifies ambient contaminated air, clean air is always present at least in the vicinity of the pond assembly 301. Therefore, those people who stand or walk around the pond assembly 301 are supplied with clean air, which makes them feel highly at rest or comfortable.

Consequently, the contaminated air purifying apparatus combined with the pond assembly 301 is highly effective to contribute to the achievement of better environmental conditions.

The air that has passed through the soil layer 317 is discharged from the slanted wall 307, and the plants 315 and the soil layer 317 are supplied with water from the water supply pipe 341. In summer, when contaminated air passes through the soil layer 317, the water supplied to the plants 315 and the soil layer 317 is evaporated and deprives the air of heat. Therefore, cool air is always present in the vicinity of the slanted wall 307 and the container 305. The contaminated air purifying apparatus may thus serve as an air conditioning unit, and make the pond assembly 301 highly valuable practically or commercially.

A modified contaminated air purifying apparatus according to the present invention which is combined with a pond assembly will be described below with reference to FIG. 18.

As shown in FIG. 18, a pond assembly 351 which incorporates the modified contaminated air purifying apparatus differs from the pond assembly 301 shown in FIG. 15 in that the pond assembly 351 is smaller in size and air passes through the soil layer 317 in an opposite direction.

The pond assembly 351 comprises an annular container 355 containing water 313 with fish therein, a conical slanted wall 357 projecting upwardly and positioned within the annular container 355, and a tree 371 supported in an erected condition by a portal post 367 mounted on an upper end of the slanted wall 357.

The slanted wall 357 is of the same structure as

that of the slanted wall according to the third embodiment, but the modified contaminated air purifying apparatus is arranged to pass air through the soil layer 317 from its upper surface toward its lower surface.

The slanted wall 357, a top panel 383 thereof, and the container 355 jointly define a space 385 below the slanted wall 357.

In the space 385, there is disposed an air pump 393 for drawing air in the space 385 and injecting the air into the water 313 in the container 355 through a pipe 391.

A pump 397 is also disposed in the space 385 for delivering the water 313 from the container 355 through a water pipe 395 and spraying the water 313 as a mist over the slanted wall 357.

Operation of the modified contaminated air purifying apparatus shown in FIG. 18 will be described below.

When the air pump 393 is actuated, it draws air into the space 385 and injects the air as bubbles into the water 313 in the container 355. Because the air in the space 385 is drawn in by the air pump 393, ambient contaminated air is drawn in through the soil layer 317 from its upper surface into the space 385. Upon passage through the soil layer 317, the contaminated air is purified by the soil layer 317.

The modified contaminated air purifying apparatus shown in FIG. 18 operates in the same manner and offers the same advantages as the contaminated air purifying apparatus according to the third embodiment of the present invention.

Furthermore, the modified contaminated air purifying apparatus shown in FIG. 18 is effective to supply oxygen to the water 313 in the container 355, and makes the pond assembly 351 more valuable as an appreciable object.

The plants 315 may be supplied with water at all times or periodically.

The slanted wall 357 is not limited to an annular shape, but may be of any of various other shapes, e.g., a rectangular shape of a given area positioned at an inner portion of a pond that is of a rectangular shape in plan.

In the arrangement shown in FIG. 15, contaminated air is introduced from the upper central region of the slanted wall 307 and flows through the soil layer 317 from its lower surface to its upper surface. However, contaminated air may be drawn in from any position, e.g., a position spaced from the pond assembly 301 through a pipe.

In the arrangement shown in FIG. 18, contaminated air is passed through the soil layer 317 from its upper surface to its lower surface and clean air is injected into the water 313 in the container 355. However, clean air may be discharged at any position, e.g., a position spaced from the pond assembly 351 through a pipe.

In the third embodiment and its modification, the space 335, 385 is defined within the slanted wall 307, 357. However, the space 335, 385 may be dispensed with, and a soil layer may be accommodated in a bottomed container, and contaminated air may be supplied to the bottom of the soil layer.

through an apertured pipe embedded in the bottom of the soil layer, or clean air may be drawn from the bottom of the soil layer.

An air purifying soil unit according to a fourth embodiment of the present invention will be described below.

FIG. 19 shows in perspective the air purifying soil unit according to the fourth embodiment of the present invention. FIG. 20 illustrates in perspective view a soil holder of the air purifying soil unit shown in FIG. 19, and FIG. 21 shows in perspective view the soil holder filled with a soil layer.

The air purifying soil unit, generally denoted at 402 in FIG. 19, comprises a soil holder 404, a soil layer 406 filled in the soil holder 404, and plants 408 cultivated on the soil layer 406.

As shown in FIG. 20, the soil holder 404 comprises a meshwork 4402 which has a high degree of porosity and is highly resistant to loads and erosion, and has a predetermined size and thickness.

The meshwork 4402 may be made of geotextile for use as an underdrainage material, for example. In the fourth embodiment shown in FIG. 19, the soil holder 404 is made of "Hechimaron" manufactured by Shinko Nylon Kabushiki Kaisha, and has a width of 50 cm, a length of 2 m, and a thickness of 10 cm.

As shown in FIG. 21, the soil layer 406 is a mixture of small particles of perlite which have diameters rang-

ing from about 2 to 4 mm, vermiculite, and peat moss, and is filled in the soil holder 404.

When the soil layer 406 is filled in the soil holder 404 while vibrating the soil holder 404 with a vibrator or the like which is used in casting concrete, the soil layer 406 can be filled in the soil holder 404 at a uniform density.

The plants 408 can be cultivated by putting seeds in the soil layer 406 thus filled in the soil holder 404.

Contaminated air can be purified by the air purifying soil unit 402 as follows:

FIGS. 22 through 25 show different air purifying structures according to the present invention which employ the air purifying soil unit 402.

In FIG. 22, a flower bed 410 is positioned on a road curb or road side, and has a recess 414 defined by a side wall 412 which has an opening 416 defined in a lower portion thereof for introducing contaminated air.

The recess 414 holds therein two stacked soil holders 404, each identical to the soil holder 404 shown in FIG. 20, and the opening 416 is positioned intermediate between the two stacked soil holders 404. The soil holders 404 are not filled with soil, and serve as a support member 418 defining an air chamber 420 therein for allowing air to flow therein.

A nylon mesh sheet 422 having a mesh size of 1 mm is placed on the support member 418.

Four stacked air purifying soil units 402, each identical to the air purifying soil unit 402 shown in FIG. 19, are disposed on the nylon mesh sheet 422, which prevents the soil from dropping from the air purifying soil units 402 into the support member 418.

The support member 418, the nylon mesh sheet 422, and the air purifying soil units 402 jointly constitute a contaminated air purifying apparatus 424. A pipe 426 is connected to the opening 416.

In FIG. 23, a contaminated air purifying apparatus 424 differs from the contaminated air purifying apparatus 424 shown in FIG. 22 in that the side wall 412 with the opening 416 defined therein is slanted.

In FIG. 24, a contaminated air purifying apparatus 424 differs from the contaminated air purifying apparatus 424 shown in FIG. 22 in that the recess 414 has a curved or uneven bottom surface 41402. To construct the contaminated air purifying apparatus 424 shown in FIG. 24, the support member 418, the nylon mesh sheet 422, and the air purifying soil units 402 are successively placed on the curved or uneven bottom surface 41402, and the support member 418, the nylon mesh sheet 422, and the air purifying soil units 402 are pressed or deformed into conformity with the curved or uneven bottom surface 41402.

In FIG. 25, a contaminated air purifying apparatus 424 differs from the contaminated air purifying apparatus 424 shown in FIG. 22 in that the recess 414 has a slanted bottom

surface 41402. Because of the slanted bottom surface 41402, the support member 418, the nylon mesh sheet 422, and the air purifying soil units 402 which are placed on the slanted bottom surface 41402 are also slanted, and gaps S are created between edges A of the support member 418 and the air purifying soil units 402 and an inner surface B of the side wall 412. The gaps S may advantageously be filled with soil for keeping the support member 418 and the air purifying soil units 402 in shape.

To purify contaminated air with any of the air purifying structures shown in FIGS. 22 through 25, the contaminated air is drawn by a pump or the like through the pipe 426 and the opening 416 into the air chamber 420, from which the contaminated air is passed upwardly successively through the air purifying soil units 402.

When the contaminated air passes through the air purifying soil units 402, it is purified thereby in the same manner as with the first embodiment of the present invention, and cleaned air is discharged from the upper surface of the uppermost air purifying soil unit 402 into the atmosphere.

In a test conducted on each of the air purifying structures shown in FIGS. 22 through 25, four air purifying soil units 402 were stacked to a total thickness of 40 cm, and two soil holders 404 were stacked as the support member 418 to a total thickness of 20 cm, and static pressures in the air chamber 420 were measured at different days while contaminated air was being passed at a linear air passage



speed of 10 mm/sec. The measured static pressures are given in the following table:

Elapsed days	0	100	200	300	400
Pressure (mmAg)	25.2	26.1	25.8	26.3	26.0

It can be seen from the above table that the soil was not made dense and no increase in the pressure loss was caused due to air passage.

The number of stacked air purifying soil units 402 can be varied depending on the linear air passage speed. If the linear air passage speed is lowered, then contaminated air may sufficiently be purified even with two stacked air purifying soil units 402.

The support member 418 which allows air to flow therethrough may be replaced with a gravel layer composed of rock fragments each having a size of about 5 cm, the gravel layer being filled in the recess 414. Such a gravel layer is also effective in purifying contaminated air.

The air purifying soil units 402 can be mass-produced at a factory, carried to a site, and placed in position, thereby constructing the contaminated air purifying apparatus 424. It is not necessary to send a soil specialist to the site to set up a contaminated air purifying apparatus 424, but a layman can assemble a contaminated air purifying apparatus 424 which includes a soil layer 406 of uniform

quality for purifying contaminated air.

The air purifying soil units 402 are prefabricated at a factory and hence the soil layer 406 are not filled and the plants 408 are not cultivated at a site. The soil layer 406 is held by the soil holder 404 which is highly porous. Consequently, the soil layer 406 is prevented from being compacted and from increasing a pressure loss during operation for a long period of time.

Since the soil layer 406 is held by the soil holder 404, the air purifying soil units 402 may be deformed as shown in FIG. 24 or slanted as shown in FIG. 25, allowing the contaminated air purifying apparatus 424 to be of a desired thickness for desired contaminated air purification even on a wavy or slanted ground.

The contaminated air purifying apparatus 424 can be manufactured inexpensively as it employs soil, and its maintenance is simple.

The plants 408 cultivated on the uppermost air purifying soil unit 402 make it possible for the contaminated air purifying apparatus 424 to be used as part of a planted landscape and hence to be installed without impairing the appearance of surroundings.

In the fourth embodiment shown in FIG. 19, the soil holder 404 which composed of a body of geotextile filled with the soil layer 406 may be surrounded and held by a frame-shaped outer wall held in contact with four surrounding end surfaces of the soil holder 404. The frame-shaped outer wall

makes it convenient for the worker to handle the air purifying soil unit 402.

Although certain preferred embodiments of the present invention has been shown and described in detail, it should be understood that various changes and modifications may be made therein without departing from the scope of the appended claims.

1     **CLAIMS**

2

3     1.    A method of purifying contaminated air, comprising  
4     the steps of:

5

6     providing a wall composed of a soil layer adapted to be  
7     populated with microorganisms, said soil layer allowing  
8     air to pass therethrough, and supporting means

9     supporting said soil layer, said supporting means

10    allowing air to pass therethrough; and

11

12    passing contaminated air through said wall.

13

14    2.    A method according to claim 1, wherein plants are  
15    cultivated on said soil layer.

16

17    3.    A method according to either one of claims 1 or 2,  
18    wherein said supporting means comprises a pair of soil  
19    holders disposed in sandwiching relation to said soil  
20    layer and a frame supporting said soil holders.

21

22    4.    An apparatus for purifying contaminated air,  
23    comprising:

24

25    a hollow body having a side wall;

26

27    an air outlet port defined in said hollow body for  
28    communicating between a space inside of said hollow  
29    body and a space outside of said hollow body; and

30

31    air flowing means disposed in said hollow body for  
32    discharging air from said space inside of said hollow  
33    body through said air outlet port into said space  
34    outside of said hollow body;

35

36    said side wall having at least a portion comprising a

1 wall composed of a soil layer adapted to be populated  
2 with microorganisms, said soil layer allowing air to  
3 pass therethrough, plants cultivated on said soil  
4 layer, and supporting means supporting said soil layer,  
5 said supporting means allowing air to pass  
6 therethrough.

7  
8 5. An apparatus according to claim 4, wherein said  
9 side wall consists entirely of said wall composed of a  
10 soil layer.

11  
12 6. An apparatus according to either one of claims 4  
13 or 5, wherein said hollow body comprises an upwardly  
14 standing tower.

15  
16 7. An apparatus according to claim 6, wherein said  
17 air flowing means is disposed in a lower portion of  
18 said upwardly standing tower, said air outlet port  
19 being defined below said air flowing means, said tower  
20 having an air inlet port defined in an upper portion  
21 thereof, said air inlet port being selectively openable  
22 and closeable.

23  
24 8. An apparatus according to either one of claims 6  
25 or 7, wherein said upwardly standing tower has water  
26 supply means for supplying water over said soil layer.

27  
28 9. An apparatus according to any one of claims 4 to  
29 8, further comprising a seat close to a lower portion  
30 of said hollow body.

31  
32 10. An apparatus according to claim 9, wherein said  
33 air outlet port is located in said lower portion of  
34 said hollow body.

35  
36 11. An apparatus according to either one of claims 9

1 or 10, wherein said seat is disposed around said hollow  
2 body.

3

4 12. An apparatus according to any one of claims 4 to  
5 11, wherein said supporting means comprises a pair of  
6 soil holders disposed in sandwiching relation to said  
7 soil layer and a frame supporting said soil holders.

8

9 13. An apparatus according to claim 12, wherein each  
10 of said soil holders comprises a finely porous sheet  
11 and a net supporting said finely porous sheet.

12

13 14. An apparatus according to claim 13, wherein said  
14 finely porous sheet is made of nonwoven fabric or rock  
15 wool.

16

17 15. An apparatus for purifying contaminated air,  
18 comprising:

19

20 a slanted wall inclined with respect to a horizontal  
21 plane, said slanted wall comprising a soil layer  
22 adapted to be populated with microorganisms, said soil  
23 layer allowing air to pass therethrough, plants  
24 cultivated on said soil layer, and supporting means  
25 supporting said soil layer, said supporting means  
26 allowing air to pass therethrough;

27

28 air flowing means for flowing contaminated air  
29 transversely through said soil layer;

30

31 a container positioned below said slanted wall and  
32 containing water; and

33

34 water supply means for supplying the water contained in  
35 said container to said soil layer.

36

1 16. An apparatus according to claim 15, wherein said  
2 slanted wall comprises a hollow body, said air flowing  
3 means comprising means for passing the contaminated air  
4 from a space inside of said hollow body transversely  
5 through said soil layer into a space outside of said  
6 hollow body.

7  
8 17. An apparatus according to claim 15, wherein said  
9 slanted wall comprises a hollow body, said air flowing  
10 means comprising means for passing the contaminated air  
11 from a space outside of said hollow body transversely  
12 through said soil layer into a space inside of said  
13 hollow body.

14  
15 18. An apparatus according to claim 17, wherein said  
16 air flowing means further comprises means for injecting  
17 the contaminated air from said space inside of said  
18 hollow body into the water contained in said container.

19  
20 19. An air purifying soil unit comprising:

21  
22 a soil holder composed of a meshwork having a high  
23 degree of porosity and resistant to loads and erosion;  
24 and

25  
26 a soil layer filled in said soil holder, said soil  
27 layer comprising a mixture of perlite, vermiculite and  
28 peat moss.

29  
30 20. An air purifying soil unit according to claim 19,  
31 further comprising an outer wall extending around said  
32 soil holder and holding outer edges of said meshwork.

33  
34 21. An air purifying soil unit according to either one  
35 of claims 19 or 20, wherein said soil holder is made of  
36 a geotextile.

1     22. An air purifying soil unit according to any one of  
2     claims 19 to 21, wherein said soil holder is shaped as  
3     a flat rectangular parallelepiped.  
4

5     23. A method of purifying contaminated air, comprising  
6     the steps of:

7

8     providing an air purifying soil unit comprising a soil  
9     holder composed of a meshwork having a high degree of  
10    porosity and resistant to loads and erosion, and a soil  
11    layer filled in said soil holder, said soil layer  
12    comprising a mixture of perlite, vermiculite, and peat  
13    moss;

14

15    placing a mesh sheet on a bottom surface of said air  
16    purifying soil unit to prevent the soil layer from  
17    dropping off said soil holder;

18

19    providing an air chamber underneath said mesh sheet;  
20    and

21

22    introducing contaminated air into said air chamber to  
23    pass the contaminated air upwardly through said air  
24    purifying soil unit for thereby purifying the  
25    contaminated air.

26

27    24. A method according to claim 23, wherein said air  
28    chamber is defined in a mesh-like support member which  
29    supports said mesh sheet and said air purifying soil  
30    unit, said mesh-like support member allowing air to  
31    pass therethrough.

32

33    25. A method according to either one of claims 23 or  
34    24, wherein a plurality of vertically stacked air  
35    purifying soil units are provided.

36



1 26. A method according to claim 25, wherein plants are  
2 cultivated on an uppermost one of said vertically  
3 stacked air purifying soil units.

4

5 27. Apparatus for purifying contaminated air  
6 substantially as hereinbefore described with reference  
7 to and as shown in the accompanying drawings.

8

9 28. A method for purifying contaminated air  
10 substantially as hereinbefore described with reference  
11 to and as illustrated by the accompanying drawings.

12

**Relevant Technical Fields**

- (i) UK Cl (Ed.N) C1P: PD, PE, PP, PW  
(ii) Int Cl (Ed.6) A61L 9/12; B01D 53/00, 53/85

Search Examiner  
A KERRY

Date of completion of Search  
30 JUNE 1995

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI, CLAIMS

Documents considered relevant following a search in respect of Claims :-  
1-28

**Categories of documents**

- |   |   |
|---|---|
| <b>X:</b> Document indicating lack of novelty or of inventive step.   | <b>P:</b> Document published on or after the declared priority date but before the filing date of the present application.        |
| <b>Y:</b> Document indicating lack of inventive step if combined with one or more other documents of the same category. | <b>E:</b> Patent document published on or after, but with priority date earlier than, the filing date of the present application. |
| <b>A:</b> Document indicating technological background and/or state of the art.   | <b>&amp;:</b> Member of the same patent family; corresponding document.   |

Category	Identity of document and relevant passages	Relevant to claim(s)
X	EP 0393408 A1 (SPACE BIOSPHERES) See Claim 1.	1, 19 at least
X	WO 93/02716 A1 (SPACE BIOSPHERES) See Claim 1.	1 at least
X	US 4975251 A (AFFILIATED INNOVATIONS) See Claim 1, column 4 lines 10-25.	1, 19 at least